The Effects of Winds and Photoionization on the Evolution of Circumstellar Disks

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Abstract. We describe the evolution of protostellar disks and their immediate surroundings when the disks are illuminated by nearby hot stars. The influence of a stellar wind from the disk's central star is also considered. We use a 2D (rotational symmetry assumed), multigrid, implicit/explicit radiation hydrodynamics code described in detail elsewhere (Richling & Yorke 2000, ApJ, 539, 258). The influx of UV radiation from an external point source results in the gradual photoevaporation of the disk — cool, molecular disk material is dissociated and heated by the penetrating FUV radiation, resulting in a neutral disk wind. This region is encased by a teardrop-shaped ionization front, where the outflowing disk wind is ionized by EUV radiation. The overall shape and spectral appearance resembles "proplyds" seen in Orion, NGC3603, and other star forming regions containing O stars. When the disk's central star has a T Tauri type wind, however, the shape and appearance can be modified significantly. The initially isotropic stellar wind is focussed into a bipolar outflow by interacting with the disk wind. When the stellar wind (containing no angular momentum) mixes with molecular material in the inner disk regions (rotating around the central star at Keplerian velocities), the result is an outflow that has too much angular momentum to remain sharply focussed. Close to the symmetry axis densities and temperatures are low. Most of the outflowing material is concentrated in a conical shell, the opening angle of which is determined by the parameters of the disk wind.

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